ATTACHMENT 3

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National Organic Standards Board
Washington, DC 20090-6456

Dear Members:

I support the National Organic Standards Board (NOSB) 1998 recommendation to allow sulfur dioxide on the National List for use in the processing of wine from organic grapes, which the Secretary rejected in this proposed rule.The 1997 proposed rule allowed use of sulfur dioxide in processing of organic wine, following a 1995 NOSB recommendation. Your more recent 1998 recommendation ~~(1998)~~ allowed use of sulfur dioxide in processing of "wine from organic grapes", but not "organic wine". In the current proposed rule, the USDA rejects all the past study, industry dialogue and consensus that resulted in these prior recommendations and proposals. I strongly urge the NOSB to stand by your 1998 recommendation in your comments to the Secretary on the current proposed rule.

I began involvement with the organic food (then "natural food") industry in 1970 when I assisted in the opening of the first natural foods store in Amherst, MA. Since then I devoted most of my time to managing natural foods cooperatives and stores, or directing events and publications for the Maine Organic Farmers and Gardeners Association. I became an importer and wholesaler of organic wines in 1985, when this industry sector was virtually unknown. I began importing organic wines from Europe at the time because the only three US organic wine producers were small and struggling with both quality and quantity issues. This early niche market for organic wines that several of us created in the 1980's became commercially attractive to many more producers and importers as overall interest in organic food increased in the 1990's. Over the last ten years, the number of domestic producers of organic wine grapes or organic wine in the US surged to over one hundred and for several years wine grapes had the most certified organic acreage of any crop in CA.

Much of this growth in organic wine production is threatened by the proposed rule. Without the ability to label wine as organic or at least "made from organic grapes", very few current producers will continue to pay a premium for certified organic grapes or pay the increased cost of organic vineyard production and certification. Although several producers currently make organic wine without added sulfur dioxide, they are unquestionably in the minority and most of them also produce organic wines with added sulfur dioxide. Their wines without added sulfur dioxide have very visible label statements to show customers that none is added. The marketplace already offers

these wines to customers, yet they are still in the minority. Market forces would have already converted the majority of producers to no sulfur added wines if this was feasible.Taking away the ability to claim organic or organically grown on the label will not push more producers into making wine without added sulfur dioxide. It will in fact push them into buying less certified organic grapes.

In addition, organic wine makers in all other countries have used and will continue to use this processing aid to maintain consistent quality. After years of deliberation and consensus, European Economic Community organic wine producer groups are recommending that EEC rules allow limited use of sulfur dioxide. I have worked many years with the Organic Grapes into Wine Alliance and the Organic Trade Association in the US to establish producer rules that would harmonize with other worldwide standards. These efforts would be seriously jeopardized by the proposed rule. Foreign producers would lose their US market for organic wine from these most restrictive rules that could be grounds for a G.A.T.T. suit in the future. Our own industry would be hampered by regulations in conflict with those of other producing nations. The growing foreign market for American organic wines will suffer from this potential trade conflict.

Why do producers need sulfur dioxide? Making wine without this ancient and traditional anti-oxidant is difficult and risky. An overwhelming majority of wine customers and professionals agree that wine quality is higher and more consistent when sulfur dioxide is used, particularly with white and blush wines. In addition, stability and shelf life are both largely reduced without sulfur dioxide. Realities of U.S. commercial wine making and distribution combined with consumer quality expectation prohibit all but our smallest producers from even attempting this type of production for domestic sales. Longer shipping times and temperature fluctuations inherent in import/export orders make use of sulfur dioxide absolutely necessary in that sector.

I am not saying that it is impossible to make a good quality organic wine without added sulfur. I personally sell several whose quality I attest to frequently. But both my suppliers and customers give fair warning to all their customers that these wines are exceedingly fragile and somewhat inconsistent. Proper handling practices are critical to their shelf life and even at best the whites (which are a large proportion of the market) cannot be trusted for much longer than one year after bottling. Much of the early and poor reputation for organic wines in the US resulted from customers and critics tasting wines made without this additive.

To force producers of organic wine to take this risk is to ask them to sacrifice quality and stability, while they still must compete in the worldwide wine marketplace. This is unacceptable to any sizable producer and to many smaller ones who put quality first in their operations. We will certainly see a drop in production and sales if this rule is implemented. With the remaining organic wines, there will be a higher percentage of inconsistent and unstable ones. Those critical of or uneasy about organic wine quality will be reinforced in their beliefs and our current loyal customers will be unable to find all but a small segment of the variety from which they now choose. If someone were asked to develop a strategy for undermining the positive growth and potential within

Nonetheless, I challenge the NOP staff and other manufacturers to show how many of these 36 allowed substances are more necessary and less harmful than sulfur dioxide in wine. The National List is not a popularity contest amongst food additives. It should be based on criteria for exceptions found in the OFPA, all of which justify inclusion of sulfur dioxide for organic wine. National List criteria are also not based on which substances have allergic reactions. If so, sea salt, soybeans and many other natural and synthetic additives would not be allowed in organic foods.

In addition, section 2111 (a) of the OFPA does not actually prohibit the existence of sulfites in organic processed foods, it only prohibits the addition of sulfites in organic production and handling. As stated above, sulfur dioxide is not technically a sulfite. BATF warning labels can state "Contains Sulfur Dioxide" instead of "Contains Sulfites" if a producer so chooses. If the simple existence of sulfites were prohibited in organic foods, no wine (and many other foods) could be labeled organic because they all contain naturally occurring sulfites. The sulfites produced from added sulfur dioxide are not prohibited any more than the sulfites produced by yeast fermentation of sulfates in grapes.

The Secretary's reasoning against sulfur dioxide use is flawed and prejudicial to organic wine production. Granted some comments were received against its use, but many were also received in favor of its use, including the recommendations of the NOSB, the Organic Trade Association, and numerous wineries, importers and wine trade associations. The OFPA wording does not prohibit the existence of sulfites in organic foods and no more prohibits even the addition of sulfites than it does any of the other 36 synthetic processing substances on the National List.

Subpart D of the proposal would allow foods with 50% or more organic ingredients to be labeled "made from organic ingredients". Wine from organic grapes with added sulfur dioxide (in normal amts under 100ppm) has over 99.99% organic ingredients. If this one safe additive were added to the National List, there is no reason why these wines should not be labeled "organic wine". Yet as now proposed, such a wine could not even be labeled "made from organic grapes".

Furthermore according to this current proposal, if a winery purchases a non-organic product other than grapes (such as apple juice) to add to their wine, this non-organic product could contain added synthetic metabisulfites in almost any amount, not just added sulfur dioxide. If then added to the wine in amounts less than 50%, the winery could actually label the finished wine "made from organic grapes"! This allowed process would add enough sulfites to prevent oxidation and still be allowed. Is this what we want for the future of organic wine? To add more non-organic ingredients and any form or amount of synthetic additives rather than simply allowing limited use of natural sulfur dioxide in organic wines that have had the same harmless additive for hundreds of years? As also recommended by the NOSB in both 1995 and 1998?

Sulfites, Wine, and Health

ALAN T. BAKALINSKY*

Sulfites refer to the various forms of sulfurous acid and are valued for their antioxidant and antimicrobial properties and enjoy widespread use as preservatives in foods, beverages, and pharmaceuticals. Use of sulfites for this purpose in wine is an ancient practice. Sulfites are also natural but minor by-products of yeast fermentation and as such are normal wine constituents. Most organisms produce sulfites as a potentially toxic but otherwise normal intermediate during digestion or synthesis of the sulfur-containing amino acids, methionine and cysteine. The condition known as human sulfite hypersensitivity is characterized by bronchoconstriction and/or anaphylaxis following ingestion of sulfite. Numerous reports in the 1980s of alleged sulfite-provoked asthma and asthma-induced fatalities following ingestion of sulfited foods eventually led the Food and Drug Administration in 1986 to ban their use on fresh fruits and vegetables and to require labeling of packaged food containing at least 10 ppm total sulfite. The Bureau of Alcohol, Tobacco and Firearms adopted an identical labelling requirement for sulfites in wine in 1988. A limited number of clinical studies have established that sulfites in wine can provoke adverse reactions among sulfite hypersensitive individuals. The sulfite hypersensitive population is believed to comprise a subset of steroid-dependent asthmatics who number no more than 200 000 in the US. The current labeling requirement in wine is a sensible and reasonable measure in view of the fact that this condition although rare, can be fatal. Model studies of sulfite metabolism in the yeast *Saccharomyces cerevisiae* suggest that acetaldehyde production during fermentation plays a key role in protecting cells from the potentially toxic effects of sulfite. This is due to the fact that acetaldehyde can react with and detoxify sulfite by forming a stable and nontoxic adduct known as 1-hydroxyethanesulfonate. Other mechanisms apparently unrelated to acetaldehyde production also serve to protect yeast from the toxic effects of sulfite.

Sulfites, in gaseous or aqueous forms, are widely used as preservatives in foods and beverages. The earliest such use is believed to have been for the disinfection of wine vessels by the ancient Egyptians (36). As an antioxidant, sulfites prevent enzymatic and non-enzymatic browning reactions. As an antimicrobial agent, sulfites prevent growth of microorganisms, or in wine fermentations, selectively inhibit undesirable organisms. Sulfites are also used as bleaching agents and conditioners in other foods. Nearly all organisms, including humans, produce sulfite as a natural by-product of normal metabolism. Although the pathways of biological formation differ among organisms, sulfite production is nearly universal.

In the United States, use of sulfites as preservatives in foods and pharmaceuticals is regulated by the Food and Drug Administration (FDA). The Bureau of Alcohol, Tobacco, and Firearms (BATF) regulates use in alcoholic beverages. The current labelling requirement which declares sulfites in wine if present at 10 parts per million (ppm) or greater, whether added or formed by yeast, stems from actions taken by the FDA in 1986 in response to numerous reports of sulfite-induced asthma.

This paper covers the topic of sulfites and their uses, describes human sulfite hypersensitivity, and sensitivity in a model organism (yeast), and addresses the background for the current labelling requirement in wine. The interested reader is referred to the reviews of Gunnison (16), Taylor *et al.* (47), Simon (39), and Gunnison and Jacobsen (17) for more thorough coverage of sulfite use and toxicity.

What Are Sulfites?

Nomenclature and chemistry: "Sulfite" is a generic term referring to all species and salts of sulfurous acid, including sulfur dioxide, its anhydride. Free sulfite includes all unbound species of sulfurous acid whose relative concentrations are dependent on pH. The relationship among the various free species is indicated below. Species in bold are identified to the right, as are the pKa values for the two dissociation equilibria.

$\mathbf{SO_2}$	sulfur dioxide, a gas
$SO_2 + H_2O = \mathbf{H_2SO_3}$	sulfurous acid or "molecular sulfite"
$H_2SO_3 = H^+ + \mathbf{HSO_3^-}$	bisulfite ion, $pKa_1 = 1.77$
$HSO_3^- = H^+ + \mathbf{SO_3^{=}}$	sulfite ion, $pKa_2 = 7.2$

At wine pH, the bisulfite ion is the predominant form of free sulfite, regardless of whether gaseous sulfur dioxide or potassium metabisulfite is added. All species are reactive with anthocyanin pigments and carbonyl compounds present in wine or produced during fermentation. The reaction products are forms of bound sulfite and constitute the largest fraction of total sulfite in wine, where total sulfite equals the sum of free and bound forms. The bound sulfites or sulfonates, do not possess the antimicrobial and antioxidant properties of free sulfites. Acetaldehyde, a yeast fermentation product, forms a particularly stable reaction product with sulfite, 1-hydroxyethanesulfonate, commonly known as acetaldehyde hydroxysulfonate or bound SO_2 acetaldehyde. Over time, free sulfite levels decrease in wine due to *(1)* formation of bound species and *(2)* irreversible oxidation to sulfate.

Use as a preservative: Sulfites are antioxidants, and antimicrobial and bleaching agents, and they are used for these purposes in a number of foods, beverages, and pharmaceuticals (5). In wine, sulfites are added to serve antioxidant and antimicrobial functions. Sulfites prevent or minimise oxidation by inhibiting the grape enzyme polyphenol oxidase, and by direct reaction with oxygen and oxygen-derivatives such as hydrogen peroxide. Antioxidants work by becoming oxidized more readily than the compounds they protect. In wine, this antioxidant function protects phenolic compounds which would otherwise become oxidized. When sulfites become oxidized, they form inert sulfates which in wine have no apparent effect on sensory attributes or on human health.

While federal regulations permit a maximum of 350 ppm total sulfite in wine, winemakers generally add the minimum necessary which is significantly less. The initial addition comes during the crushing of grapes. In the absence of mold and rot, a minimal addition is sufficient. Because sulfites are unstable, winemakers monitor free and total levels and make adjustments as necessary during processing.

Of all the species of free sulfite, only undissociated sulfurous acid, H_2SO_3, possesses significant antimicrobial activity. This is because the other forms are unable to traverse microbial cell membranes, whereas sulfurous acid can. From the dissociation equilibria given above, it follows that the lower the pH of a wine, the more sulfurous acid is present. Thus, if the same amount of sulfite is added to two different wines, one at pH 3.2 and the other at pH 3.6, for example, the former wine will have greater antimicrobial activity than the latter. The bound forms of sulfite appear not to have antimicrobial activity. Some studies have shown that sulfite does not inhibit certain non-*Saccharomyces* yeasts indigenous to grape musts, particularly in red varieties. These include species of *Zygosaccharomyces*, *Torulaspora*, *Brettanomyces*, and *Schizosaccharomyces* (14,20,21). In contrast, wine strains of other yeasts, *Kloeckera*, *Candida*, *Pichia*, and *Hansenula* do appear to be significantly more sensitive to sulfite than *Saccharomyces* (37).

Enzymatic effects: Studies on the effects of sulfite on energy metabolism have shown that the glycolytic pathway is effectively impaired. Millimolar concentrations of sulfite cause a rapid depletion of the ATP content of yeast at low pH values. The most important enzymes affected are glyceraldehyde-3-phosphate dehydrogenase and alcohol dehydrogenase (23,24,32). Inhibition of glycolysis at the step of glyceraldehyde-3-phosphate dehydrogenase is thought to be largely responsible for the decrease in ATP generation. Among enzyme activities assayed in sulfite-treated yeast cells, glyceraldehyde-3-phosphate dehydrogenase was shown to be the most sensitive to sulfite. Glyceraldehyde-3-phosphate dehydrogenase catalyzes the conversion of glyceraldehyde-3-phosphate to 1,3-diphosphoglycerate, which in a subsequent step is converted to 3-phosphoglycerate with the concomitant production of ATP. Inactivation of the enzyme blocks the glycolytic pathway and causes a depletion of ATP, since the two ATPs expended earlier in the pathway can not be recovered.

Inhibition of alcohol dehydrogenase was also observed (32). This enzyme catalyses the reduction of acetaldehyde to ethanol by NADH during alcoholic fermentation. While this step does not involve the production of ATP directly, the NAD^+ regenerated by acetaldehyde reduction is an obligate electron acceptor in the earlier reaction catalysed by glyceraldehyde-3-phosphate dehydrogenase. Thus, when alcohol dehydrogenase is inhibited, NAD^+ is no longer produced, and this in turn prevents the oxidation of glyceraldehyde-3-phosphate, indirectly causing depletion of ATP. The most obvious result of this effect is the blocking of ethanol formation.

Yeast toxicity: When sulfite crosses the cell membrane as undissociated sulfurous acid, it is converted into bisulfite and sulfite ions because of the near-neutral intracellular pH. At the same time, the intracellular pH decreases due to the dissociation, which in turn lowers the transmembrane pH gradient, assuming an acidic growth medium, as in wine. This would tend to retard or inactivate processes that require energy derived from proton-motive force such as active transport (34). Maier *et al.* (32) measured the effect of sulfite on the intracellular proton concentration of glucose-starved yeast cells and found that in 1 m*M* sulfite the average intracellular proton concentration increased about 100-fold. This intracellular acidification specifically stimulated the F1-ATPase resulting in ATP depletion. Yeast cells treated with formic acid underwent a similar internal acidification analogous to the sulfite treated-cells. However, compared to sulfite the effect on ATP content was much less marked. This finding suggested that dissipation of the proton-motive force during intracellular acidification of itself was of little or secondary importance with respect to sulfite-induced depletion of ATP.

Sulfite can combine with anthocyanin pigments to form a colorless adduct. Although this must occur to some extent in wines, the amounts of added sulfite are so low that it is of no practical significance. However, this bleaching action is exploited in the manufacture of maraschino cherries where high levels of sulfite are deliberately added to bleach natural color at an early stage in the process.

Sources of sulfites. ***Biological sources:*** Sulfite is a normal metabolite in humans and other animals, plants, and in microorganisms. In humans, the major route of formation is believed to be as an intermediate in the metabolism of the sulfur-containing amino acids methionine and cysteine which are liberated during the digestion of sulfur-containing proteins (Fig. 1).

The sulfite forms non-enzymatically from the spontaneous desulfination of 3-sulfinylpyruvate and is rapidly oxidized by the mitochondrial enzyme sulfite oxidase. Although sulfite oxidase levels vary greatly be-

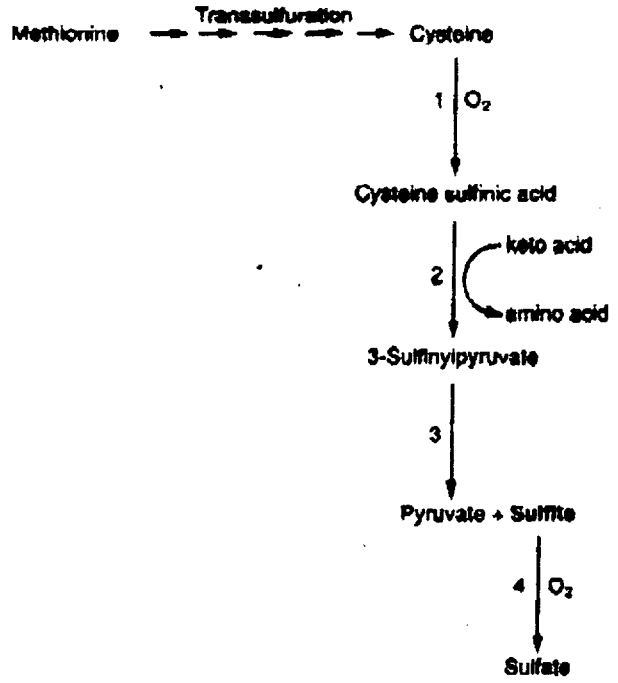

Fig. 1. Formation of sulfite from cysteine and its conversion to sulfate in mammals: 1, cysteine dioxygenase; 2, cysteine sulfinic acid transaminase; 3, spontaneous desulfination of 3-sulfinylpyruvate; 4, sulfite oxidase. [Adapted from Gunnison and Jacobsen (17).]

tween species and within different tissues, the enzyme is very efficient. Of the estimated 1.5 to 2.5 grams of sulfate excreted daily in the urine of normal adults, most is produced via sulfite oxidase (17). The enzyme is essential for normal development, as congenital sulfite oxidase deficiency in humans is associated with increased excretion of sulfite, thiosulfate, and cysteine-S-sulfonate, instead of sulfate, and severe neurological abnormalities resulting in mental and physical retardation. Afflicted individuals do not survive infancy. Sulfate-reducing activity, distinct from the catabolic route shown in Figure 1, leading to the formation of sulfite in rabbit polymorphonuclear neutrophils has been reported as a minor source of sulfite, although the biological role(s) of the sulfite formed in this reductive pathway and the extent of its occurrence in other mammals are unknown (15).

Formation of sulfite in plants and most microorganisms occurs through reductive sulfate assimilation which is the route of methionine and cysteine biosynthesis. This pathway is not operative in mammals which are unable to make either amino acid *de novo*, but are able to make cysteine from dietary methionine via trans-sulfuration (Fig. 1). The reductive assimilation pathway as it occurs in the yeast *Saccharomyces cerevisiae* is shown in Figure 2.

The methionine and cysteine formed are used for protein synthesis and other needs, and sulfite occurs only as an intermediate. Conversion of sulfate into methionine and cysteine is an energy-dependent process and yeast will not carry out the conversion if it is unnecessary, *i.e.*, when these amino acids are present in sufficient quantity in the growth medium. Methionine and cysteine are generally deficient in grape juice, and thus the pathway is operative during vinification. In one study of red and white grape juices in the Napa Valley, methionine levels were consistently found to be very low and cysteine was absent (25). Wine yeasts are known that excrete a variable amount of sulfite during fermentation. This is an incompletely understood natural phenomenon that is a function of yeast strain (genetic makeup), nutritional status of the grapes, and other influences. Suzzi *et al.* (44) found that among 1700 wine strains of *S. cerevisiae* grown under comparable conditions, 80% produced less than 10 mg/L, and only four produced more than 50 mg/L. Kinetic differences in ATP sulfurylase, a key enzyme in the pathway that converts intracellular sulfate to adenosine 5'-phosphosulfate, and in sulfate uptake in "low" and "high" sulfite-producing yeast strains account for some of the complexity (12,22).

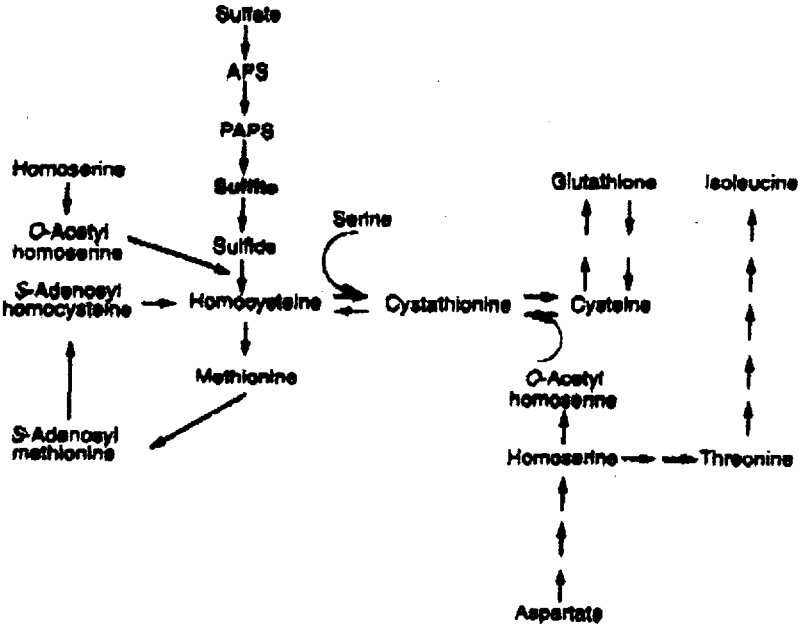

Fig. 2. Formation of sulfite via reductive sulfate assimilation and related metabolism in the yeast *Saccharomyces cerevisiae*. APS, adenosine 5'-phosphosulfate; PAPS, 3'-phosphoadenosine 5'-phosphosulfate. [Adapted from Jones and Fink (29) and Thomas *et al.* (46).]

Studies in beer fermentation have shown that sulfite formation is favored by low levels of methionine and aspartate and high levels of isoleucine, serine, threonine, and glucose (18,31). As noted above, high methionine levels repress the enzymatic reduction of sulfate to sulfite and the findings in beer are consistent with this. How do aspartate levels affect sulfite synthesis? Aspartate is a precursor of *O*-acetyl homoserine which condenses with hydrogen sulfide to produce homocysteine, the immediate precursor of methionine (Fig. 2). It seems reasonable that low levels of aspartate would limit synthesis of *O*-acetyl homoserine which in turn would be unavailable for condensation with hydrogen sulfide. The accumulated hydrogen sulfide could inhibit sulfite reductase which would lead to a build-up of sulfite. Korch *et al.* (31) rationalized the effects of threonine and isoleucine levels on sulfite synthesis in the following manner. Threonine and isoleucine are derived from homoserine and high levels of either compound block their own syntheses by inhibiting homoserine formation (Fig. 2). A limiting amount of homoserine would reduce formation of *O*-acetyl homoserine and result in the situation described above for low aspartate levels. The effect of glucose on sulfite formation is explained differently (31). High glucose leads to greater formation of acetaldehyde which can form a stable adduct with sulfite, 1-hydroxyethanesulfonate. This compound is not a substrate for reduction by sulfite reductase and thus sulfite is diverted from methionine formation. Limiting methionine leads to greater activity of the methionine biosynthetic enzymes which causes more sulfite to be formed.

A specialized pathway of sulfite formation is known among a group of strict anaerobic bacteria that use sulfate instead of oxygen as a terminal electron acceptor. These soil organisms produce sulfite as an intermediate in forming massive amounts of hydrogen sulfide. The hydrogen sulfide in turn is used as a source of electrons by symbiotic photosynthetic species (42).

Air pollutant: Sulfur dioxide is a major urban air pollutant resulting from combustion of sulfur-containing fossil fuels. The ancient practice of burning sulfur wicks to disinfect wine vessels involves the same oxidative reaction:

$$S + O_2 = SO_2$$

The gaseous sulfur dioxide released to the atmosphere may become hydrated to form sulfurous acid. In either form, it oxidizes readily to form sulfuric acid. Sulfuric is stronger than sulfurous acid, and dissolved in rainwater constitutes one form of acid rain. Human exposure to acute air pollution and to less severe episodes is generally correlated with an increase in mortality and morbidity. However, sulfur dioxide comprises only one component of air pollution; others of health concern being particulates, nitrogen oxides, ozone, and smoke. In a number of studies that have separated out the effects of the different components, sulfur dioxide has not been singled out in association with elevated mortality or morbidity (2,10,33,38,51).

Human Sulfite Hypersensitivity

Definition: Various terms have been used to describe the condition in which individuals present with asthma and/or anaphylaxis after exposure to sulfites. These include "sulfite hypersensitivity", "sulfite sensitivity", "sulfite-induced anaphylaxis", "sulfite-induced bronchoconstriction", and "sulfite-induced asthma". All refer to an extreme sensitivity to sulfite without implying a mechanism because the mechanism(s) through which sulfite elicits toxicity are unknown. While nearly all asthmatics are more prone to inhaled sulfur dioxide-induced bronchospasm than non-asthmatics, this reaction is not considered to be a manifestation of true sulfite hypersensitivity. Sulfite hypersensitive subjects are considered those who react to ingested capsular sulfites. Evidence for involvement of the immune system has been equivocal and thus, the condition is not considered an allergy (17).

Occurrence: Estimates of the number of sulfite hypersensitive individuals vary, but it is generally believed that the condition occurs almost exclusively among a small fraction of steroid-dependent asthmatics. If one assumes that 20% of the 10 million asthmatics in the US are dependent on steroids and that 10% of them are sulfite hypersensitive, 200 000 individuals in the US may be afflicted. However, the lack of uniform diagnostic procedures for the assessment of sulfite hypersensitivity has limited the accuracy of such estimates. Generally, pulmonary function measured as a decrease in forced expiratory volume in one second (FEV_1) is monitored after administration of sulfite according to the protocol of Stevenson and Simon (43), or variants of it. Subjects are challenged in single-blind fashion with increasing doses of capsular potassium metabisulfite (from 1 to 50 mg) in 30 minute intervals. Determinations of FEV_1 are made prior to the first dose and then approximately 25 minutes after each capsule except when earlier measurements are indicated by symptomology of the subject. A similar procedure is carried out with placebo capsules 24 hours before to establish baseline pulmonary function. The provocative dose in this protocol is assumed to be the last dose given before a significant decrease in FEV_1 is observed and not the sum of all doses given to that point.

Although, the first reports of asthma and allergic-like adverse reactions to ingested sulfites were published in the 1970s (30,35), it was not until after 1980 that reports of sulfite hypersensitivity became frequent enough to attract the attention of the scientific community, consumer groups, the food industry, and regulatory agencies. Because many case reports of sulfite-induced adverse reactions implicated lettuce, cut fruit, and guacamole from salad bars, the condition became known as the "salad bar syndrome". Asthma remains the only well-documented adverse reaction associated with sulfite hypersensitivity. Although the Food and Drug Administration (FDA) had long considered the use of sulfur dioxide and sodium and potassium salts of sulfite in foods to be generally recognized as "safe" (GRAS), the FDA revoked the GRAS status of sulfites

for use on fresh fruits and vegetables in 1986 and also required that sulfited foods be labelled if detectable residues remained, at least 10 ppm (13). This action was taken in response to thousands of reports from consumers alleging sulfite-induced reactions including 20 alleged deaths. Discussion and study of the issue by scientists, consumers, and the food industry revealed significant reservations about continued safe use of sulfites on fresh fruits and vegetables. Such use in restaurant salad bars was clearly causing many of the adverse reactions, and the 1986 regulation was meant to stop the practice (46). In 1988, the Bureau of Alcohol, Tobacco, and Firearms (BATF) followed the lead of the FDA in requiring that all wines bottled or sold in the US bear the statement "contains sulfites" if at least 10 ppm are present.

While reaction to ingested capsular sulfite establishes sulfite hypersensitivity, it does not necessarily follow that hypersensitive individuals will react to the bound forms of sulfite present in foods. Generally, bound forms of sulfite predominate over free sulfite in foods and beverages. An exception to this is in lettuce, where significant free sulfite remains after addition. It is probably no coincidence that sulfited lettuce has been implicated in so many reports of alleged sulfite hypersensitivity. The question of whether bound forms of sulfite can elicit adverse reactions has received limited attention. Taylor *et al.* (46) examined the sensitivity of eight sulfite-hypersensitive individuals to a variety of sulfited foods, and found that four failed to respond to any of them. The other four reacted to challenges with sulfited lettuce but not to all the other foods tested. Two of the four reacted to sulfited grape juice. In an animal study, acetaldehyde hydroxysulfonate administered orally at high dose was found to cause gastric lesions in both normal and sulfite oxidase-deficient rats. An increase in urinary sulfite in the sulfite oxidase-deficient animals suggested that this bound form of sulfite was metabolized to acetaldehyde and free sulfite (26).

Jacobsen *et al.* (28) has proposed that sulfite oxidase deficiency in chronic asthmatics may play a role in the sulfite hypersensitivity syndrome. They reasoned that such individuals may be unable to adequately detoxify exogenous sulfite present in foods. Thus, at least some sulfite is absorbed and enters systemic circulation. While massive levels of sulfite may overwhelm the capacity of sulfite oxidase in normal individuals, the circulating sulfite does not trigger an adverse reaction because of the absence of conditions which predispose the chronic asthmatic. How systemic sulfite triggers hypersensitivity is not understood (17). Data on human sulfite oxidase levels in normal individuals is limited, but suggests great variation between tissues. For example, Beck-Speier *et al.* (6) reported 135 times greater sulfite oxidase activity in human liver than in lung. A single report in abstract form (27) on sulfite oxidase levels in skin fibroblasts in normal subjects and in sulfite-sensitive asthmatics indicated differences that deserve further study (D. W. Jacobsen, personal communication, 1992). Because of the difficulty, if not impossibility, of determining levels directly in major organs, Gunnison and Jacobsen (17) have suggested an indirect determination of whole body sulfite oxidase status by measurement of abnormal sulfur metabolites (sulfite, thiosulfate, and cysteine-S-sulfonate) following sulfur challenge with methionine.

Simon *et al.* (40) demonstrated that oral administration of 1 to 5 mg of vitamin B_{12} (cyanocobalamin) prior to sulfite ingestion fully or partially blocked bronchoconstriction in six out of six sulfite-sensitive asthmatic patients. Jacobsen *et al.* (28) proposed that vitamin B_{12} acted by catalysing sulfite oxidation in a manner similar to its ability to catalyse thiol oxidation. Independently, Bhat and Bhat (7) and Alfibarro *et al.* (1) reported similar success in using vitamin B_{12} to block sulfite-induced bronchoconstriction.

Is wine a cause of sulfite-induced hypersensitivity reactions? The issue of sulfite in wine first became controversial in the early 1980s when sulfited foods (lettuce) were recognized as a cause of adverse reactions. Because use of sulfite in wine is nearly universal, the question of whether wine sulfites could elicit similar reactions became a matter of some importance. The issue was complicated by the fact that wine is extremely complex, containing hundreds of different chemicals, many with known pharmacological properties. Thus, the numerous anecdotal reports of adverse reactions including asthma following ingestion of wine could not usually be ascribed to a particular compound with confidence. One tragic incident of this sort described fatal anaphylaxis following ingestion of sulfite-containing wine (50). The victim was a steroid-dependent asthmatic who had previously suffered an acute asthma attack after eating packaged dried apricots in 1982 and developed dizziness, nausea, and dyspnea after eating a salad at a restaurant in 1983. A diagnosis of sulfite sensitivity was made based on this history although an oral sulfite challenge was not administered. The patient began to avoid known sulfite-containing foods although this incident occurred prior to the legal requirement for sulfite labelling. The patient died in 1985 shortly after drinking a few sips of white wine containing 92 mg/L sulfite. Postmortem examination showed gross and histological features of acute and chronic asthma but was otherwise normal. Did the sulfite in this wine trigger the fatal anaphylactic reaction? Based on the information presented, it seems rather likely, but we cannot know for sure.

A limited number of clinical studies have been undertaken in which sulfite-sensitive asthmatics have been challenged with sulfited wine. The most significant conclusion from these studies is that sulfites in wine can indeed trigger bronchoconstriction among sulfite hypersensitive individuals. To determine if sulfite in wine could trigger bronchoconstriction among non-steroid dependent asthmatics, Halpern *et al.* (19) challenged 24 such subjects (and an equal number of non-asthmatics) with white wine containing 160 mg/L total sulfite and found that one quarter of the asthmatics suffered a significant decrease in FEV_1. Two subjects became symptomatic and were subsequently chal-

lenged in double blind fashion with model wine solutions, one containing 150 mg/L total sulfite (20 mg/L free and 130 mg/L bound) and one control without sulfite. One subject had slight, but significant, decreases in FEV_1 following ingestion of both model wine solutions, suggesting a cause other than sulfite. The other patient had an insignificant reaction after ingesting the control solution and a significant decrease in FEV_1 following ingestion of the sulfited solution, implicating sulfite as the probable cause. Dahl *et al.* (11) challenged in double blind fashion 18 patients with a history of red-wine-induced asthma with three types of wine arbitrarily designated "low sulfur dioxide, high amine", "high amine, high sulfur dioxide", and "low amine, low sulfur dioxide". The base wine was a red Châteauneuf-du-Pape containing "low sulfur dioxide" (6 mg/L free and 52 mg/L total) and "high amine" (9 mg/L). The amine level presumably referred to histamine. Potassium metabisulfite was added to the wine to produce the "high sulfur dioxide, high amine" version containing 185 mg/L free and 270 mg/L total sulfite. To produce the "low amine, low sulfur dioxide" type, the wine was treated with bentonite to remove amines, although the amount of histamine that remained in the wine following treatment was not indicated. Clearly, the bentonite did not just remove amines. Nine of the eighteen subjects reacted positively to one or more of the wines with a decrease in FEV_1 of greater than 15%, and in all cases, the most severe reactions were observed after ingestion of the wine with the high sulfur dioxide content. The subjects were not challenged with capsular sulfite to confirm sulfite-sensitivity. These results suggest that sulfite is an important factor in red wine-induced asthma. Tenscher *et al.* (48) challenged ten sulfite-sensitive subjects (7 confirmed on the basis of capsule challenge) in a double blind protocol with bound forms of sulfite. None of the subjects reacted to placebo challenge, but six of the seven capsule reactors reacted to either 1-hydroxyethanesulfonate or to the adduct that forms between sulfite and pyruvate, demonstrating that bound sulfites, that predominate in wine, can indeed provoke reactions in sulfite sensitive asthmatics. Two of six subjects tested by Bhat and Bhat (7) were presumptive sulfite sensitive asthmatics (both were steroid-dependent) and one experienced a 53% decline in FEV_1 following a 5-ounce wine challenge (S. Taylor, personal communication, 1996). The other was not sensitive to the wine whose sulfite content was not specified.

Based on these limited studies, it is reasonable to conclude that sulfite-sensitive individuals can experience adverse reactions from the sulfite in wine. A small fraction of asthmatics are at greatest risk. However, individuals who have been drinking wine with no adverse effects should be able to continue to do so without worrying about sulfite.

Sulfite Sensitivity in a Model Organism

How does yeast avoid sulfite toxicity? On-going studies in the author's laboratory have focused on how yeast avoids the potential toxicity of sulfite, produced as a normal metabolite during fermentation. Yeast was chosen as a model system because of the advantages it offers as an experimental organism, because natural variation in sulfite tolerance has been observed among strains, with wine strains exhibiting the greatest resistance, and because of potential relevance to humans. It is reasonable to ask of what possible relevance to human sulfite hypersensitivity is a study of sulfite metabolism in yeast, when it is clear that yeast and humans produce sulfite through very different metabolic routes? One answer is that while routes of formation indeed differ, cellular targets of sulfite toxicity may be similar. Proteins or other molecules with which sulfite reacts to elicit hypersensitivity in humans may have counterparts in yeast.

The initial step was to identify sulfite-sensitive yeast variants or mutants whose growth was inhibited by sulfite concentrations that were tolerated by normal strains. The rationale behind this approach was that such mutants were likely to be specifically impaired in the ability to detoxify sulfite. Four sensitive mutants representing defects in four different genes and one resistant mutant were isolated from a mutagenized culture of a laboratory strain of *S. cerevisiae* (52). None of the strains were defective in methionine or cysteine biosynthesis which eliminated loss of sulfite reductase activity as a possible cause of sensitivity. An independently tested sulfite reductase mutant was found to be sulfite-sensitive, presumably because of its inability to metabolize sulfite. Three of the four sensitive mutants were found to produce a reduced amount of acetaldehyde, a compound that can react with and detoxify sulfite. However, acetaldehyde was also under-produced by the resistant mutant.

Subsequent molecular cloning of one of the genes in which defects caused sensitivity identified *GRR1*, a gene involved in glucose metabolism (3). Cells with a non-functional *GRR1* gene have previously been shown to have a number of problems, including slow growth on glucose. Based on an analysis of the *grr1* mutant and a comparative study of normal cells growing on different carbon sources, it has become clear that acetaldehyde production by yeast is an important means of detoxifying sulfite. It is also apparent that acetaldehyde production is not the only means. A second gene implicated in the sulfite sensitive syndrome has been identified, but its sequence has not been informative and it is not clear how defects in it can cause sensitivity (3). One gene, *FZF1*, that plays a role in conferring resistance to sulfite in yeast appears to have a regulatory function, and we speculate that is may control a pump able to rid the cell of excess sulfite, perhaps in the form of 1-hydroxyethanesulfonate (3,8,9).

Through this study, we hope to develop a clear understanding of how yeast deals with sulfite, a normal but potentially toxic metabolite and expect that some of what we learn may have relevance to the ways humans metabolize this same compound.

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CHARTRAND IMPORTS

Sulfite Content Current Vintages
French Organic Wines

3/20/00

	Total Sulfite-Parts per Million
Chateau de Boisfranc Beaujolais 1998	23
Guy Bossard Cabernet Franc de Bretagne 1998	21
Guy Bossard Muscadet Sèvre et Maine sur lie 1998	45
Guy Bossard Muscadet Sèvre et Maine 1999	45
Bossard-Thuaud Méthod Traditionnelle NV Brut Sparkling Wine	50
Domaine des Cèdres Cotes du Rhone 1997	69
Domaine des Cèdres Cotes du Rhone 1998	69
Les Romarins Cotes du Ventoux 1995	40
Les Romarins Cotes du Ventoux 1996	78
Guy Chaumont Bourgogne Chardonnay 1997	35
Guy Chaumont Bourgogne Pinot Noir 1997	15
Guy Chaumont Bourgogne Pinot Noir 1998	15
Domaine de Picheral Vin du Pays d'Oc Merlot 1997	49
Domaine de Picheral Merlot 1998	48
Jacques Frelin Vin de Pays d'Oc Rouge 1997	79
Jacques Frelin Vin de Pays d'Oc Rouge 1998	79
Jacques Frelin Cotes du Rhone 1997	51
Kawarau Estate New Zealand Sauvignon Blanc 1998	90
Chateau Méric Graves Blanc 1997	90
Chateau Méric Graves Rouge 1997	55
Chateau Moulin de Peyronin Bordeaux Rouge 1998	87
Serge Faust Carte d'Or NV Brut Champagne	62
Domaine St. Anne Bordeaux Blanc 1997	64
Domaine St. Anne Bordeaux Blanc 1998	64
San Vito Chianti 1998	28
Terres Blanches Les Baux de Provence Rouge 1996	54
Terres Blanches Les Baux de Provence Rouge 1997	54

U.S. law requires wine with Total Sulfites over 10 parts per million (ppm) to have warning "CONTAINS SULFITES". U.S. maximum sulfite limit is 350ppm. Average sulfite content of all wine is 80-120ppm, with some up to 350ppm. French organic standards only allow 100ppm in red, 120ppm in white wines.

Badger Mountain

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Organic Viticulture

Since 1988 Badger Mountain has been committed to 100% organic viticulture. We use all-natural methods of controlling insects, fungus and weeds. Progressive, natural farming techniques are at the heart of all of our wines. In 1990, Badger Mountain was the first vineyard to be Washington State Certified Organic.

Insect control: The vineyard is monitored weekly. Our goals are to create a good habitat for predatory (good guys) insects, and a poor habitat for the bad guys that damage the grapes. If the bad guys are overwhelming the good guys, we take corrective action to balance the battle, such as applying natural soap compounds (Safer Soap) and other all-natural materials, instead of pesticides.

Weed Control: Badger Mountain uses a European made in-row cultivator (hoe plowing) to control weeds in the grape rows and mow the grass cover in the center. This replaces the use of herbicides.

Fertility: All pomace (grape skins and seeds) is composted and returned to the vineyards. All-natural blood meal and fish meal are added as needed for nitrogen and other trace elements. These natural, organic fertilizers are used instead of synthetic fertilizers.

Vines: The vines are managed by hedging, which improves sun penetration and air movement, developing character and balance in the grapes. Crop and shoot thinning controls vigor and limits yields, increasing flavors and aromas in the finished wines.

Soils and moisture: Badger Mountain soils are of volcanic origin. Our annual rainfall is 9 inches, 95% of it occurring between November and March. With our irrigation we can maintain a controlled environment of watering, another natural tool in controlling vine vigor and crop yields.

Sulfur Dioxide

At Badger Mountain, sulfur dioxide is used at very low levels of 06 to 30 parts per million. The Bureau of Alcohol, Tobacco and Firearms standards allow for up to 350 parts per million.

Grape fermentations **naturally** generate about 8 to 10 parts per million sulfites, so no other additions are made for four or five months. At time of bottling, sulfur dioxide levels are adjusted to 20 to 30 parts per million.

Sulfur dioxide is a ***naturally*** occurring type of sulfite. Mined sulfur is heated into a liquid and used to protect wine from oxidation. This same method has been used to protect wine from oxidation for hundreds of years.

Professor Roger Boulton of the University of California at Davis, Department of Viticulture and Enology, confirms that ***even if no sulfur dioxide is added to a wine, fermenting yeasts will provide SO2 from the naturally occurring inorganic sulfates in all grape juices.***

Therefore, Professor Boulton asserts, ***it is impossible for any wine to be completely free of sulfur dioxide.***

After making many wines both with and without added sulfur dioxide under controlled laboratory conditions, UC Davis concluded that ***wines made with added SO2 are far superior in taste, color and stability to wines made without them.***

We at Badger Mountain are committed to producing wines of character and distinction, using only organic farming methods, and gentle handling from vine to bottle. We balance tradition and technology to enhance the flavor and character of our grapes and the wines they yield.

SULFITES

Sulfites describes a group of compounds that are forms of sulfurous acid, and includes sulfur dioxide (SO2). Sulfur dioxide has a long history associated with food preservation, and there is strong evidence that ancient Egyptians used it in preservation of wine. Sulfur dioxide has been in recorded use in wine preservation since early Rome, and European winemakers have used it regularly for centuries. It's common winery forms (sulfur dioxide, a gas; potassium bisulfite or metabisulfite, both powders) added to liquid act the same way, releasing sulfur dioxide. This compound is a very effective antioxidant, and has strong antimicrobial properties as well. The result is wine protected from premature oxidation, which causes browning and off flavors, and protection against the growth of yeasts, molds, and bacteria.

At Badger Mountain, sulfite levels are closely monitored throughout the production process. Wine yeasts naturally produce up to 20 parts per million (ppm) of SO2 during fermentation (Professor Roger Boulton, UC Davis). During the course of production, minimal amounts of sulfites are added in the form of pure mined sulfur that has been heated and liquefied. Levels are kept at the measurable minimum that provides complete protection. The exception to this is the Badger Mountain *NSA* wines, where careful handling and bottling use only the naturally occurring sulfites from fermentation to act as preservative. These wines are bottled with a variation on the Badger Mountain package, and labeled as *No Sulfites Added.*

The concern over the use of sulfites in the United States arose over the use of extremely high levels of SO2 on salad bars to prevent browning of fruits and lettuce. The use of 1000-3000 parts per million SO2 in this application resulted in asthmatic reactions-some severe. In 1986 the US government stepped in and the FDA banned the use of sulfites on fresh fruits and vegetables. Also ,as a part of this ruling, the FDA required other foods and beverages containing sulfites to be labeled as such-even those which contain very low levels. Wine requires lower levels of sulfites to achieve stability because of it's alcohol content, naturally high acidity, and low pH. At Badger Mountain Vineyards the finished product typically contains 30-60 ppm SO2. The *NSA* wines usually contain 7-15 ppm SO2 in the finished product, with those under 10 ppm not requiring the Federally mandated "Contains Sulfites" statement.

Sulfites in Wine

Jim Lapsley
Orleans Hill Winery

There is a great deal of confusion regarding sulfites in wine, especially in "Organic wine": Are sulfites natural? Why are they added? Are they a health hazard? This brief review is intended to answer basic questions.

What are sulfites?: Sulfites are chemical compounds created by the interaction of sulfur dioxide (SO_2) with the acidified water (H_2O) found in wine. The reaction, described below, creates a negatively charged bisulfite ion which can react with other compounds.

$$SO_2 + H_2O \rightarrow HSO_3^- \text{ (bisulfite ion)} + H^+ \text{ (hydrogen proton)}$$

Free Sulfites, Bound Sulfites and Total Sulfites: The bisulfite ion, with its negative charge, can react with many compounds, binding to them and becoming a "bound sulfite." The bisulfite ions that remain unbound are termed "free SO_2." The "free" plus the "bound" sulfites together are called "total sulfites," which is what the Federal government measures. If a wine contains 10 parts per million (ppm) or more of total sulfites, the label must bear the infamous "contains sulfites" warning. Although "bound" sulfites can, in unusual conditions, unbind, in most circumstances bound sulfites remain bound. From a winemaking and health perspective it is the free sulfite, in the form of the bisulfite ion, that interests the winemaker.

Why do winemakers add sulfites to wine?: Sulfite additions are generally made to control two types of spoilage: Microbial spoilage and oxidative spoilage.

Oxidative Spoilage: When oxygen comes in contact with wine, several spoilage reactions are possible. First, oxygen can oxidize the ethyl alcohol in wine, forming acetaldehyde. Aldehyde is the major sensory component of sherry wines--an aroma fine in sherry, but not desireable in most varietal table wines. Second, oxygen can change the resonance of flavenoids, a class of phenolic compounds common in wines, causing the wine to show brown hues, a visual indicator of oxidative spoilage. The bisulfite ion can bind with these compounds, reversing (to some degree) the oxidative spoilage. The bisulfite ion can also bind with oxygen, thus reducing available oxygen in wine and reducing the possibility of oxidative spoilage. Oxidative spoilage can occur in both red and white wines, but is most noticeable in white wines, since the pigments and tannins in red wine can also react with oxygen, thus reducing available oxygen to react with ethyl alcohol. Since white wines have fewer pigments and tannins than do red wines, white wines have less of a "buffer" against oxidative spoilage than do red wines. This explains why some red wines may have no added sulfites, but not show any oxidative damage, while the vast majority of white wines will quickly show oxidation without judicious use of sulfites.

Microbiological Spoilage: Stored bulk wine can often be attacked by spoilage organisms such as film yeast or acetic bacteria. Most spoilage organisms can be controlled by very small amounts of SO_2. Depending upon the pH of the wine, 20 to 30 ppm of bisulfite ion is generally enough to control such microbiological spoilage and to prevent the production of noticeable amounts of acetic acid (vinegar) in the wine. To put this amount in perspective, one part per million is equivalent to one inch in 15.7 miles. 30 ppm is roughly equivalent to one inch in a half mile.

Added and "Natural" Sulfites: Some sulfites are produced in <u>most</u> (not all) yeast fermentations and often an organic wine will end up with more than 10ppm <u>total</u> sulfites even if no sulfites are added. It is important to realize that these trace amounts of sulfites produced during fermentation are almost 100% in the <u>bound</u> form and are not available as bisulfite ions to control potential oxidative or microbiological spoilage. During fermentation, which can last from a few days to a few weeks depending upon fermentation temperature, the yeast enzymes convert sugar to ethanol through a multistepped pathway--the conversion of sugar to alcohol is not a one step, instantaneous event. Many of the intermediate compounds can bind with sulfites, which the yeast are also creating in minute amounts. Thus, by the conclusion of fermentation, virtually all of the sulfites created by the yeast have bound up with intermediate compounds, and no "free SO_2" is present. For this reason most winemakers will make a sulfur dioxide addition ("Added Sulfites") following the conclusion of fermentation, especially if they are producing a white wine.

Sulfites and Health: Do sulfites pose a health risk? The short answer is no--not in the amounts generally found in wines which average about 80-100ppm total of which about 30ppm is free (in the bisulfite ion form). This level is 10 times less than the level used to preserve such dried fruits as raisins or apricots. There have only been a few medical studies on sulfur dioxide reactions at the levels used in wine. These studies indicate that 1 person in 200 (half of one percent) reacts to sulfites in wine--generally with a tightening of the bronchial passage and/or headache. While 1 in 200 is a small percentage, it does mean that one or two customers a day at a busy wine shop or restaurant may indeed have an allergic reaction to sulfites. While such a reaction is not life-threatening (there are no recorded deaths due to sulfites in wine), depending upon personal sensitivity it can be extremely unpleasant for the affected individual.

Why does Orleans Hill add sulfites?: First off, we don't add sulfites to our red wine, the Organic Zinfandel, which is fermented as whole cluster fruit and for the past two years has had no detectable sulfites by government test. We do add minimal amounts (30ppm total) to our white and blush wines to insure high quality and varietal aroma. Our first commitment is to the production of high quality wine from organically grown grapes. Tests at our winery show that the same wine bottled without this minimal level of sulfite will brown and lose quality. Because the wines are made with no or low sulfites, they should be stored in cool areas, kept away from direct sunlight, and generally treated as high quality fresh produce.

ORGANIC WINE WITH SULFITES?

All wines made without sulfites are not 'organic wines'. In fact, only wines made from organically grown grapes are eligible for such a distinction. However there are many wines available today that are made from organically grown grapes, some with sulfites added and some without any sulfites added. (Look for the words 'CONTAINS SULFITES' on the wine label which means the wine contains more than 10ppm total sulfur, whether added or naturally produced during fermentation. The upper limit allowed by law in the USA is 350ppm.) From here confusion sets in and political agendas and special interests further cloud the underlying issue: Are sulfites in wine harmful to your health? Some say emphatically yes. But these no sulfite advocates offer little if any scientific data in support of their claims but merely refer to existing organic legislation or positions promoted by groups like the Center for Science in the Public Interest (who are known to have an agenda against alcohol). To unlock the truth takes some work and a little open mindedness.

There is truth that less than 1% of the population is hyper-sensitive to sulfites wherever they are found: foods, drugs or liquids. So in the interest of the health and public safety of these hyper-sensitive individuals a government warning (CONTAINS SULFITES) must be placed on any food or drink containing sulfites (Somehow drugs got left out eventhough there are many sulfur based drugs). Contrariwise, an overwhelming abundance of information exists confirming that no short or long-term health dangers are associated with sulfites in foods/drinks for the general public (This is simply an allergic/hyper-sensitivity issue). Sulfites are part of our daily body chemistry functions in amounts both ingested and manufactured by the body itself that far exceed the normal intake of sulfite added products. This information in no way reduces the need for hyper-sensitive people to heed the CONTAINS SULFITES warnings.

Interestingly enough the level of sensitivity to sulfites varies among people. The vast majority of people have no sensitivity to sulfites in the wide range of

levels found in food and drink. Researchers conclude that most sensitivity doesn't even start until levels are above 100ppm. Obviously there will be some individuals that are extremely hyper-sensitive that even lower levels will affect them. For people that suspect they may be sulfite hyper-sensitive they need to cautiously find their threshold level of sulfite under which they can tolerate.

After careful review of the French and German processing standards for organic wines by many of the original organic wine producers, importers, distributors and some retailers, a comprehensive set of organic wine processing standards was adopted (not without vigorous discussions) and an organization was founded, OGWA (Organic Grapes into Wine Alliance)in 1989. OGWA continues to work toward the inclusion of its standards in the Federal organic food act.

OGWA's wine processing standards allow (as do the French, German,etc.) a limited use of sulfite in wine not to exceed 100ppm total sulfur and to be derived only from pure SO2 gas bubbled into water until saturation (the wine industry satandard source of sulfite is a chemical powder called potassium metabisulfite).

Fitzpatrick Winery is a founding member of OGWA and adheres to OGWA's wine processing standards. Our commitment to producing a most civilized beverage in a most responsible way is genuine and will survive the test of time. The use of sulfites in our wines is limited (most often less than 50ppm) but a necessary part of producing quality world class wines. "I feel strongly that our judicious use of sulfite in our wine in no way compromises the benefits that they are wines made from organically grown premium wine grapes". Uncork the magic of Fitzpatrick wines.

Brian Fitzpatrick
winemaker/general manager
Fitzpatrick Winery